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**From:** Ronald J. Kubovcik (Registration No. 25,401)  
**Date:** July 28, 2008  
**Pages :** 17 including this cover sheet.

**Re :** Appl. No. : 10/519,073  
Applicant : Atsushi FUKUI et al.  
Filed : December 23, 2004  
TC/A.U. : 1795  
Examiner : Cynthia K. Lee  
Dkt. No. : MAM-056  
Cust. No. : 20374

Confirmation No. 7337

Document transmitted herewith: (1) APPEAL BRIEF (With Appendices)  
(2) PTO-2038 for \$510.00

(Due: April 12, 2008)

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND INTERFERENCES

APPEAL BRIEF

Ex parte Atsushi FUKUI et al.

LITHIUM SECONDARY BATTERY AND METHOD FOR MANUFACTURING THE SAME

Serial Number: 10/519,073  
Filed: December 23, 2004  
Group Art Unit: 1795  
Examiner: Cynthia K. Lee

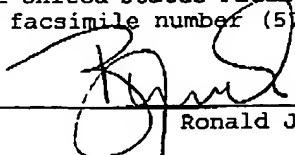
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
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Appl. No. : 10/519,073 Confirmation No. 7337  
Applicant : Atsushi FUKUI et al.  
Filed : December 23, 2004  
TC/A.U. : 1795  
Examiner : Cynthia K. Lee  
Dkt. No. : MAM-056 07/29/2008 PCHOMP 00000002 10519073  
Cust. No. : 20374 01 FC:1402 510.00 OP

BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

July 28, 2008

Sir:

This is an appeal from the decision dated December 28, 2007, of the Primary Examiner finally rejecting claims 2 to 8, 13 to 15 and 20 to 22 in this application.

(i) REAL PARTY IN INTEREST

The real party in interest is SANYO ELECTRIC CO., LTD. of 5-5, Keihanhondori 2-chome, Moriguchi-shi, Osaka 570-8677, Japan.

(ii) RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences which will directly affect or be directly affected by or have a bearing on the Board's decision in this appeal.

(iii) STATUS OF CLAIMS

Claims 2 to 8, 13 to 15 and 20 to 22 are pending in this application. Claims 1, 9 to 12, 16 and 19 have been cancelled. Claims 2 to 8, 13 to 15 and 20 to 22 are appealed. Claims 2 to 8, 13 to 15 and 20 to 22 as finally rejected appear in the attached Appendix.

(iv) STATUS OF AMENDMENTS

No amendments were filed subsequent to the final rejection.

(v) SUMMARY OF CLAIMED SUBJECT MATTER

Claim 2, the only independent claim involved in this appeal, is directed to a negative electrode for a rechargeable lithium battery which includes a conductive metal foil current collector and an active material layer provided on a surface of the current collector and which comprises a polyimide binder and particles of active material containing silicon and/or a silicon alloy. The electrode is characterized in that the current collector has mechanical properties of at least 80 N/mm<sup>2</sup> tensile strength, at least 30 N/mm<sup>2</sup> proportional limit, at least 1.0 % elongation at break and at least 0.03 % elastic elongation limit and the polyimide binder has mechanical properties of at least 50 N/mm<sup>2</sup>

tensile strength, at least 10 % elongation at break, at least  $2.5 \times 10^{-3}$  J/mm<sup>3</sup> strain energy density and up to 10,000 N/mm<sup>2</sup> elastic modulus. (Page 2, lines 10-22). The current collector and binder possess the mechanical properties specified in claim 2 at the point when fabrication of the negative electrode is complete. (Page 2, line 25, to page 3, line 3).

Appellants have discovered that when the current collector and binder have the specified mechanical properties, the active material layer is restrained from flaking, or falling, off from the current collector during a charge-discharge reaction (during which the active material layer containing silicon and/or a silicon alloy expands and shrinks in volume as it stores and releases lithium). (Page 3, lines 3-8, and 11-20; page 3, line 24, to page 4, line 8).

As a result, a reduction of current-collecting capacity within the electrode is suppressed to improve charge-discharge cycle characteristics. (Page 4, lines 8-10).

(vi) GROUND OF REJECTION TO BE REVIEWED ON APPEAL

(1) Whether claims 2 to 8, 13 to 15 and 20 to 22 are unpatentable under 35 U.S.C. 103(a) over Nobufumi (JP 2000-012088) in view of Solomon (U.S. Patent No. 4,927,514) and Fujimoto (U.S. Patent No. 5,468,571), as evidenced by the glass transition point

and melting point of polytetrafluoroethylene.

(vii) ARGUMENT

(1) The Examiner has failed to properly support a case of obviousness of the claims of the present application under 35 U.S.C. § 103(a).

The position of the Examiner is that it would have been obvious to use the polyimide binder of Fujimoto in place of the PTFE binder in the negative electrode of Nobufumi (which uses electrolytic copper foil as a current collector) and to sinter the electrode at a temperature (in view of Solomon) that does not cause deleterious polymer decomposition. The mechanical properties recited in claim 2 are stated to be "met by a process in which a surface roughened copper foil current collector and the binder are sintered below the decomposition temperature and above the melting temperature of the binder." (Final Action, page 16, lines 3-6).

Initially, it is noted that the Examiner has not provided any rationale why a person of ordinary skill in the art would have been motivated to combine Nobufumi, Fujimoto and Solomon for the purpose of obtaining a negative electrode in which the binder and the current collector possess specific mechanical properties as required by the claims on appeal. The Examiner's position is a

hindsight reconstruction of the prior art based on appellants' teaching in their specification relating to sintering of a negative electrode active material mixture on a current collector.

Moreover, the Examiner's hindsight reconstruction is flawed because, first, the Examiner has not provided a proper rationale explaining why a person of ordinary skill in the art would have been motivated to apply the teachings of Solomon relating to a platinum black air cathode to the negative electrode of the lithium secondary battery of Nobufumi. The properties desired of the platinum black air cathode for an electrolytic cell for producing ozone of Solomon in which an active layer comprising platinum black and PTFE are deposited on a support layer comprising a mixture of particulate carbon with hydrophobic polymer have not been shown by the Examiner to be the same properties required for the negative electrode for a nonaqueous secondary battery of Nobufumi in which an active layer comprising a silicon-containing material, carbon and a binder are deposited on an electrolytic copper foil.

In the Final Action the Examiner states that the process of Solomon "would have been predictable to Nobufumi's electrode because the temperature range that does not cause deleterious polymer decomposition would allow the binder to still be present in the electrode." (Final Action, page 16, lines 1-4 from the bottom

of the page).

This statement begs the issue. The Examiner has not explained why decomposition of the binder in the negative electrode of Nobufumi is necessarily deleterious or undesired.

Second, the Examiner has not provided any reasoning explaining why the proposed modification of Nobufumi would have necessarily resulted in a negative electrode in which the binder and current collector possess the requisite properties of the binder and current collector of the present invention. The Examiner has cited nothing to support a position that all polyimide binders and all current collectors will possess such properties when heated for "0.5 to 10 minutes" the sintering time taught in Solomon (see Col. 5, lines 18-20, and Example 1). Appellants note that in the examples in their specification, heat treatment times are on the order of tens of hours. Also, Nobufumi's current collectors are not limited to electrolytic copper foil. In the example of Nobufumi, paragraph [0061], copper, nickel, titanium and stainless steel, are mentioned as the "metallic foil charge collector."

For these reasons, the combination of references proposed by the Examiner is insufficient to support a case of *prima facie* obviousness of the claims of the present application.

(2) The comparative data in the application demonstrate the

materiality of the mechanical properties of the current collector and of the mechanical properties of the binder of the active material layer of the negative electrode of the present invention in obtaining unexpected superior charge-discharge cycle characteristics.

The showing in the examples of the criticalness of the mechanical properties of the current collector and of the mechanical properties of the binder of the active material layer of the negative electrode of the present invention demonstrates the non-obviousness of the negative electrode of the present invention and rebuts any prima facie obviousness alleged to be supported by the cited prior art. (Compare, for example, the data in Table 5 of appellants' specification for the properties of batteries A1-A2 of the invention using a current collector which has the mechanical properties recited in claim 2 with battery B1 in which properties of the current collector are not within the scope of claim 2; the data in Table 7 for batteries A1, A9 and A10 of the invention in which the binder is within the scope of claim 2 with battery B2 in which properties of the binder are outside of the scope of claim 2; and the data in Table 15 for the properties of batteries A15 and A16 of the invention using a current collector which has the mechanical properties recited in claim 2 with battery B5 in which

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APPEAL BRIEF

properties of the current collector are not within the scope of claim 2).

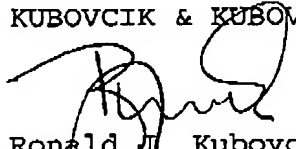
The Examiner in the Advisory Action takes the position that the combination of prior art will inherently possess the claimed properties. Such position is improper because it is a comparison of the claimed invention with subject matter that does not exist in the prior art and amounts to a comparison of the results of the invention with the results of the invention. (See MPEP § 716.02(e) (III)).

The Examiner's case of obviousness is insufficient under 35 U.S.C. § 103(a) and reversal of the final rejection of the claims is in order and is respectfully requested.

Please charge any required fees or credit any overpayment to our Deposit Account No. 111833.

Respectfully submitted,

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(viii) CLAIMS APPENDIX

2. A negative electrode for a rechargeable lithium battery which includes a conductive metal foil current collector and an active material layer provided on a surface of the current collector and comprising a polyimide binder and particles of active material containing silicon and/or a silicon alloy;

said negative electrode characterized in that said current collector has mechanical properties of at least 80 N/mm<sup>2</sup> tensile strength, at least 30 N/mm<sup>2</sup> proportional limit, at least 1.0 % elongation at break and at least 0.03 % elastic elongation limit and said binder has mechanical properties of at least 50 N/mm<sup>2</sup> tensile strength, at least 10 % elongation at break, at least  $2.5 \times 10^{-3}$  J/mm<sup>3</sup> strain energy density and up to 10,000 N/mm<sup>2</sup> elastic modulus;

after provision of said active material layer on the surface of said current collector, heat treatment being carried out at a temperature higher than a glass transition temperature and lower than a decomposition temperature of said binder to improve adhesion of the binder to the current collector.

3. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said mechanical properties are imparted to the current collector by a thermal history of the sintering treatment.

4. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said mechanical properties are imparted to said current collector by subjecting the current collector to a heat treatment before said active material layer is provided on the surface of the current collector.

5. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that a thickness X of said active material layer, a thickness Y and a surface roughness Ra of said current collector satisfy the relationships  $5Y \geq X$  and  $250Ra \geq X$ .

6. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said surface of the current collector that carries the active material layer thereon has a surface roughness Ra of at least  $0.2 \mu\text{m}$ .

7. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said current collector comprises a copper foil, a copper alloy foil or a metal foil having a copper or copper alloy surface layer.

8. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said current collector comprises an electrolytic copper foil, an electrolytic copper alloy

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foil or a metal foil having an electrolytic copper or copper alloy surface layer.

13. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said binder has said mechanical properties after a thermal history of said heat treatment.

14. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said binder has a linear expansion coefficient of  $0.1 \times 10^{-5} - 30 \times 10^{-6} \text{ }^{\circ}\text{C}^{-1}$ .

15. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said binder has a glass transition temperature of up to  $450 \text{ }^{\circ}\text{C}$ .

20. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said active material particles have a mean particle diameter of up to  $10 \text{ }\mu\text{m}$ .

21. The negative electrode for a rechargeable lithium battery as recited in claim 2, characterized in that said active material layer includes a conductive powder.

22. A rechargeable lithium battery including the negative

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electrode as recited in claim 2, a positive electrode containing a positive electrode material and a nonaqueous electrolyte.

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(ix) EVIDENCE APPENDIX

None

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(x) RELATED PROCEEDINGS APPENDIX

None

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